UNITED STATES PATENT OFFICE.

HERBERT N. McCOY, OF CHICAGO, ILLINOIS.

PROCESS OF CONCENTRATING CARNOTITE SANDSTONE.

1,195,698. Specification of Letters Patent. Patented Aug. 22, 1916.

No Drawing. Application filed February 12, 1916. Serial No. 78,023.

To all whom it may concern:

Be it known that I, HERBERT N. McCOY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Processes of Concentrating Carnotite Sandstone, of which the following is a specification.

The object of this invention is to provide a process for concentrating the values in so-called carnotite, a mineral containing uranium, vanadium and potassium, and by reason of its uranium content containing also radium. This ore is at present the principal commercial source of radium.

Pure carnotite is a very soft, bright yellow mineral, which is very rarely found in large masses. Its usual occurrence is in the form of a very thin coating upon grains of sand with which it forms a friable, yellowish sandstone, which occurs almost exclusively in Colorado and Utah. This sandstone, impregnated with carnotite, is commonly known as carnotite, although the actual percentage of the latter mineral may be quite small.

The carnotite sandstone is readily crushed so as to separate the sand granules; and when the sand so obtained is subjected to any of the well known wet or pneumatic methods of concentration, a considerable part of the carnotite may be separated as a concentrate. Such methods, especially the pneumatic method, are in extensive use. These methods, however, do not afford a clean separation for the reason that the very thin coating of carnotite adheres firmly to each sand granule. The separation is not improved by finer grinding of the sand, as the sand grains are thereby broken with the result that very fine silica passes into the concentrate with the carnotite.

I have discovered that I can secure an excellent separation as between the carnotite and the sand as follows:—The ore is crushed in such manner as to separate or detach the sand grains without fracturing the individual grains to any material extent. The sand is then sifted through a screen of about one twenty-fifth to one fiftieth of an inch aperture, and is mixed with a small quantity of water to form a sludge, one gallon of water for each fifteen pounds of the carnotite sand being a suitable proportion. The mixture is now thoroughly agitated for one or several hours in any suitable apparatus, for example a revolving barrel or drum. As a result of this treatment the coating of carnotite is worn away from the surfaces of the sand grains by a process of attrition, and is brought into such a finely-divided state that upon adding to the mixture in the drum a sufficient proportion of water, say five gallons of water to each fifteen pounds of carnotite sand, the charge readily separates into two layers, the carnotite remaining suspended in the water, and the heavy sand, each grain of which is now thoroughly freed from its coating of carnotite, settling to the bottom. The water suspension of the carnotite is decanted, and by filtering, using any well known method, the carnotite concentrate is obtained as a filter-cake, in form readily available for further treatment.

The above process is highly effective, and is based upon the recognition of the fact that the ore, so-called carnotite, consists of sand granules each having a firmly adhering coating of carnotite. The sand consists largely, or often almost wholly of silica (quartz) and is therefore very hard; whereas the carnotite is much softer and is gradually worn off by attrition, as the wet mass is agitated. I have also found that not only is the carnotite removed from the sand by this process, but that radium is likewise separated with the carnotite. In fact, it appears to be impossible to separate a considerable part of the radium from the sand, except by a process of attrition. The reason for this is that a considerable portion of the radium is embedded in the sand grains up to depths of about 0.0001 millimeter. The radium is not distributed uniformly through the sand grains, but is only embedded in the surface layer. This condition arises during the formation of the radium from uranium, in which formation the atoms of radium are shot off by recoil (compare Rutherford, "*Radio-Active Substances and Their Radiations*," 1913, page 174) with such great velocity as to cause them to penetrate the sand grains to the appreciable depths above noted. It is only by a process of attrition, as above described, that the surface layers of the sand grains can be worn away, and a complete separation obtained as between the radium and the sand.

In ordinary carnotite-bearing sandstone, such as that above referred to, there is a